

gained by their larger brains? Why has there been this selection in all lines of animal descent of increased cerebral tissue?

I think we gain a key to the answer to this question by a consideration of the differences of cerebral quality between man and apes. Man is born with fewer ready-made tricks of the nerve centres—those performances of an inherited nervous mechanism so often called by the ill-defined term “instincts”—than are the monkeys or any other animal. Correlated with this absence of inherited ready-made mechanism, man has a greater capacity for developing in the course of his individual growth similar nervous mechanisms (similar to but not identical with those of “instinct”) than any other animal. He has a greater capacity for “learning” and storing his individual experience, so as to take the place of the more general inherited brain-mechanisms of lower mammals. Obviously such brain-mechanisms as the individual thus develops (habits, judgments, &c.) are of greater value in the struggle for existence than are the less specially-fitted instinctive in-born mechanisms of a race, species or genus. The power of being educated—“educability” as we may term it—is what man possesses in excess as compared with the apes. I think we are justified in forming the hypothesis that it is this “educability” which is the correlative of the increased size of the cerebrum. If this hypothesis be correct—then we may conclude that in all classes of Vertebrata and even in many Invertebrata—there is and has been a continual tendency to substitute “educability” for mere inherited brain-mechanisms or instincts, and that this requires increased volume of cerebral substance. A mere spoonful of cerebral tissue is sufficient to carry abundant and highly efficient instinctive mechanisms from generation to generation; but for the more valuable capacity of elaborating new brain-mechanisms in the individual as the result of the individual's experience of surrounding conditions, a very much larger volume of cerebral tissue is needed.

Thus it seems probable that “educability” has increased in those Mammalia which have survived. The ancient forms with small brains though excellent “automata” had to give place, by natural selection in the struggle for existence, to the gradually increasing brains with their greater power of mental adaptation to the changing and varied conditions of life: until in man an organism has been developed which, though differing but little in bodily structure from the monkey, has an amount of cerebral tissue and a capacity for education which indicates an enormous period of gradual development during which, not the general structure, but the organ of “educability,” the cerebrum, was almost solely the objective of selection.

Two lines of speculation and inquiry are strongly affected by the hypothesis thus sketched.

Firstly, as to the general laws of progressive development of bodily structure by the operation of natural selection—is it not probable that in various groups of animals, just as in the case of man among the Primates, the operation of natural selection on bodily structure (limbs, teeth, hair, horns, &c.) must have been checked, or even altogether suspended, by the transference of selection to the all-important organ of educability, the cerebrum or corresponding nerve-centres? Adaptation by means of the mental powers must take the place of adaptation of bodily structures. The educable animal leaves the ground and learns to climb trees in order to gain its food, whilst in another race the slower process of alteration of bodily form is evolving a long neck to reach the green twigs, or a ponderous strength of limb which can pull trees to the ground. Many similar cases will suggest themselves to the reader in which, even in lower animals, the capacity of learning by experience must (as it were) defeat and turn from its route the otherwise triumphant transformation of bodily structure.

Secondly, the question of the transmission of acquired characters is largely touched by these speculations. The character which we describe as “educability” can be transmitted, it is a congenital character. But the results of education can not be transmitted. In each generation they have to be acquired afresh, and with increased “educability” they are more readily acquired and a larger variety of them. On the other hand, the nerve-mechanisms of instincts are transmitted, and owe their inferiority as compared with the results of education to the very fact that they are not acquired by the individual in relation to his particular needs, but have arisen by selection of congenital variation in a long series of preceding generations.

To a large extent the two series of brain-mechanisms, the “instinctive” and the “individually acquired,” are in opposition

to one another. Congenital brain-mechanisms may prevent the education of the brain and the development of new mechanisms specially fitted to the special conditions of life. To the educable animal—the less there is of specialised mechanism transmitted by heredity, the better. The loss of instinct is what permits and necessitates the education of the receptive brain.

We are thus led to view that it is hardly possible for a theory to be further from the truth than that espoused by George H. Lewes and adopted by George Romanes, namely that instincts are due to “lapsed” intelligence. The fact is that there is no community between the mechanisms of instinct and the mechanisms of intelligence, and that the latter are later in the history of the development of the brain than the former, and can only develop in proportion as the former become feeble and defective.

These few lines—for the abruptness of which I apologise—will, I trust, serve to show the interesting nature of the speculations connected with the significance of the size of the cerebrum in various Mammalia and other animals. Some of the suggestions obtained from a consideration of the subject will, if carried out in detail, be found of first-rate importance in building up the science of comparative psychology.

ZONES IN THE CHALK.

THE philosophical observations on the genus *Micraster*, which were communicated by Dr. A. W. Rowe to the Geological Society in 1899, have been followed by the publication of his special researches on the zones of the white chalk on the coasts of Kent and Sussex. This second most valuable essay has been communicated to the Geologists' Association (*Proceedings*, vol. xvi. March 1900), who are to be congratulated on having such an addition to their published works. The paper follows along the lines so ably sketched out more than twenty years ago by Dr. Barrois; and Dr. Rowe, in nearly all cases, confirms the previous zonal distinctions and largely increases our knowledge. He shows how invaluable it is to collect stage by stage, and to pay the closest attention to the minute changes which the fossils, and particularly the *Micrasters*, undergo. The paper is essentially a zoological one, invaluable in indicating the succession of life, and as a contribution towards the genesis of species.

The ordinary subdivisions of lower, middle and upper chalk, which are important when we deal with purely geological problems, are not here dealt with; but the author, who apparently takes little interest in stratigraphy apart from fossils, admits that “we can generally recognise the zones from the appearance of the chalk alone, and that the fossils act as confirmatory evidence.” This, indeed, is the experience of those who have worked at zones, and it is only by utilising properly all the evidence that satisfactory results can be obtained. Lithological evidence, often invaluable, is essentially local; the palæontological evidence, so ably and exhaustively dealt with by Dr. Rowe, is clear and uniform throughout the areas with which he deals. The fossils, as he remarks, “never fail us,”—that is to say, when you find them, their testimony is safe after the experience he has gained. He has been fortunate in having such an excellent series of sections to work at, and these are well depicted in two folding plates, drawn by Mr. C. Davies Sherborn. Inland, of course, the observer has only a pit-section or road-cutting here and there to act as a guide to the zonal divisions, but no doubt with the aid of the clear descriptions given by Dr. Rowe, and of the ascertained thicknesses of the several zones, it might be possible and even desirable to trace inland their approximate boundaries, if any useful purpose were thereby gained. In any case, Dr. Rowe's work will be appreciated alike by field-geologists and palæontologists. Prof. J. W. Gregory describes a new Echinoderm, and Dr. F. L. Kitchin describes a new species of *Terebratulina* from the chalk.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. H. Yapp has been appointed assistant curator of the Herbarium under Prof. Marshall Ward.

Prof. Clifford Allbutt was on April 23 appointed physician to Addenbrooke's Hospital, in accordance with the recent agreement between the University and the governors.

Dr. Adami and Mr. de Soyres have been appointed delegates